Long-Term Outcomes of Coronary Stent Implantation versus Bypass Surgery for the Treatment of Unprotected Left Main Coronary Artery Disease

Revascularization for Unprotected Left _MAIN_ Coronary Artery Stenosis: _COM_parison of _P_ercutaneous Coronary _A_ngioplasty versus Surgical _RE_vascularization from Multi-Center Registry:

The MAIN-COMPARE Registry

Co-Principal Investigators:

Seung-Jung Park, MD, PhD, Ki-Bae Seung, MD, PhD

for the MAIN-COMPARE Study investigators

MAIN-COMPARE Registry
Stenting (BMS vs. DES) vs. CABG

January, 2000

Wave I (Era of BMS)

LMCA disease (N=775)

BMS (N=318)   CABG (N=448)

Second quarter, 2003

Wave II (Era of DES)

LMCA disease (N=1536)

DES (N=784)   CABG (N=690)

June, 2006

Total (N=2240)   PCI (N=1102)   CABG(N=1138)

Study Administration

- **P.I. :** Seung-Jung Park, MD, PhD, Asan Medical Center
  Ki-Bae Seung, MD, PhD, Kagnam St Mary's Hospital
- **Sponsors:** The Korean Society of Interventional Cardiology
  CardioVasuclar Research Foundation (CVRF)
- **Investigating centers:**
  - Asan Medical Center, Seoul, Korea
  - Kangnam St Mary's Hospital, Seoul, Korea
  - Yoido St Mary's Hospital, Seoul, Korea
  - Kyungpook National University Hospital, Daegu, Korea
  - Gachon University Gil Medical Center, Incheon, Korea
  - Seoul National University Hospital, Seoul, Korea
  - Seoul National University Bundang Hospital, Seongnam, Korea
  - Samsung Medical Center, Seoul, Korea
  - Ajou University Hospital, Suwon, Korea
  - Yonsei University Medical Center, Seoul, Korea
  - Chonnam National Univeristy Hospital, Gwangju, Korea
  - Chung-Nam University Hospital, Daejon, Korea
- **Data analysis and management:** CVRF and Clinical Research Center in AMC
- **Local independent event committee:** University of Ulsan Medical College

Background

- To date, CABG has been traditionally regarded as the "gold standard" therapy for the treatment of unprotected left main coronary artery (LMCA) stenosis.

- LMCA stenosis also might be considered as a suitable target for coronary stenting because of its large caliber, short lesion length and lack of tortuosity.

Background

- The availability of DES has improved the efficacy outcomes, as compared to BMS, and prompted re-evaluation of the optimal strategy for LMCA disease.

- There have been no prospective, randomized clinical trials involving long-term evaluation of the percutaneous or surgical treatment for unprotected LMCA disease.

Objective

- To compare long-term outcomes in patients with unprotected LMCA disease, who underwent CABG or stenting in multi-centers to provide a very large clinical registry from Korea.

Enrollment Criteria

Inclusion Criteria

• Patients with unprotected left main disease (>50% by visual estimation) who underwent stenting or isolated CABG
(** The LMCA is considered unprotected if there are no patent coronary artery bypass grafts to the LAD or the LCX)

Exclusion Criteria

• Prior CABG
• Concomitant valvular or aortic surgery
• ST-elevation MI
• Cardiogenic shock at presentation

Primary Outcome Measures

- Death
- Composite outcomes of death, Q-wave MI, and stroke
- Target-vessel Revascularization

Databases

- Baseline clinical, angiographic, procedural or operative data, and outcomes of interest were collected using the dedicated internet-based reporting system.

- All outcomes of interest were confirmed by source documentations reported at each hospital and were centrally adjudicated by the local events committee at the University of Ulsan College of Medicine, Asan Medical Center, Seoul.

- For validation of complete follow-up data, information about vital status was obtained through July 15, 2007, from the National Population Registry of the *Korea National Statistical Office* using a unique personal identification number.

Statistical Analysis

- To reduce treatment selection biases and potential confounding in an observational study and approximate a randomized trial, we performed rigorous adjustment for significant differences in characteristics of patients by use of the propensity-score matching.

- Using greedy nearest-neighbor matching algorithm, we created a propensity-score-matched pairs (a 1:1 match). Specifically, we sought to match each patient with stenting to one with CABG who had a propensity score that was identical to 5 digits. If this could not be done, the algorithm then proceeded sequentially to the lowest digit match (a 4-, 3-, 2-, or 1-digit) on propensity score to make "next-best" matches.

- For each of concurrent comparisons (Wave I and Wave II), a new propensity score for PCI versus CABG was incorporated for each analysis.

Results

PCI patients (N=1102)

Primary reason for PCI

Patient or Doctor preference in the absence of high surgical risk	**1073 (97%)**
Not-eligible (not operable or high risk) for CABG (High-surgical risk)	**29 (3%)**
Old age $\geq$ 80 years and poor performance	8
Limited life expectancy	3
Current malignancy	2
Concurrent severe medical illness	12
No suitable bypass conduits	4

Procedural Characteristics for CABG and PCI

Variable	CABG (n = 1102)	PCI (n = 1138)
CABG Group		
Off-pump surgery (%)	42	-
At least one arterial conduit (%)	98	-
IMA to LAD Graft (%)	98	-
Grafts / Patients (Mean $\pm$ SD)	2.9$\pm$1.0	-
PCI Group		
Bare-metal stents(%)	-	29
Drug-eluting stents (%)		71
Sirolimus stents of DES (%)		(77)
Paclitaxel stents of DES (%)		(23)
Number of stents at LM site	-	1.2$\pm$0.5
Length of stents at LM site	-	28$\pm$21
Average stent diameter at LM site	-	3.5$\pm$0.4

Baseline Characteristics

Variable	Stents (n=1102)	CABG (n=1138)	P Value
Demographic characteristics			
Age (yr)			<0.001
Median	62	64	
Interquartile range	52-70	57-70	
Male sex (%)	70.7	72.9	0.24
Cardiac or Coexisting conditions (%)			
Diabetes mellitus			
Any diabetes	29.7	34.7	0.01
Requiring insulin	6.8	8.2	0.22
Hypertension	49.5	49.4	0.94
Hyperlipidemia	28.5	32.6	0.04
Current smoker	25.6	29.8	0.03

Baseline Characteristics

Variable	Stents (n=1102)	CABG (n=1138)	P Value
Previous coronary angioplasty	18.1	11.0	<0.001
Previous myocardial infarction	8.1	11.6	0.005
Previous congestive heart failure	2.5	3.3	0.21
Chronic obstructive pulmonary disease	2.0	2.0	0.97
Cerebrovascular disease	7.1	7.3	0.84
Peripheral vascular disease	1.5	5.4	<0.001
Renal failure	2.7	3.0	0.71
Ejection fraction (%)			<0.001
Median	62	60	
Interquartile range	57-67	52-66	

Baseline Characteristics

Variable	Stents (n=1102)	CABG (n=1138)	P Value
Electrocardiographic findings			0.53
Sinus rhythm	97.8	97.1	
Atrial fibrillation	2.0	2.7	
Other	0.2	0.2	
Clinical indication (%)			<0.001
Silent ischemia	3.0	2.2	
Chronic stable angina	32.0	19.9	
Unstable angina	55.2	68.1	
NSTEMI	9.8	9.8	

Baseline Characteristics

Variable	Stents (n=1102)	CABG (n=1138)	P Value
Angiographic characteristics (%)			
Extent of diseased vessel			<0.001
Left main only	25.2	6.2	
Left main plus single-vessel ds	24.0	10.5	
Left main plus double-vessel ds	26.0	26.3	
Left main plus triple-vessel ds	24.8	57.0	
Right coronary artery disease	35.9	70.7	<0.001
Restenotic lesion	2.9	1.2	0.005

After Propensity-Matching
to approximate a randomized trial

Baseline Characteristics of Propensity-Matched Patients (542 pairs)

Variable	Stents (n=542)	CABG (n=542)
Demographic characteristics		
Age (yr)		
Median	64	64
Interquartile range	56-71	56-70
Male sex (%)	71.6	71.2
Cardiac or Coexisting conditions (%)		
Diabetes mellitus		
Any diabetes	32.7	33.0
Requiring insulin	7.6	7.9
Hypertension	49.5	50.0
Hyperlipidemia	29.4	30.1
Current smoker	29.4	30.1

Baseline Characteristics of Propensity-Matched Patients

Variable	Stents (n=542)	CABG (n=542)
Previous coronary angioplasty	14.8	15.1
Previous myocardial infarction	9.0	10.0
Previous congestive heart failure	2.9	3.0
Chronic obstructive pulmonary disease	2.6	2.2
Cerebrovascular disease	7.4	6.6
Peripheral vascular disease	2.0	2.0
Renal failure	3.7	3.9
Ejection fraction (%)		
Median	61	61
Interquartile range	54-66	55-66

Baseline Characteristics of Propensity-Matched Patients

Variable	Stents (n=542)	CABG (n=542)
Electrocardiographic findings		
Sinus rhythm	97.6	96.7
Atrial fibrillation	2.4	3.1
Other	0.0	0.2
Clinical indication (%)		
Silent ischemia	2.8	2.7
Chronic stable angina	29.2	28.4
Unstable angina	57.4	57.9
NSTEMI	10.7	11.1

Baseline Characteristics of Propensity-Matched Patients

Variable	Stents (n=542)	CABG (n=542)
Angiographic characteristics (%)		
Extent of diseased vessel		
Left main only	11.8	11.1
Left main plus single-vessel disease	17.0	16.2
Left main plus double-vessel disease	31.7	33.9
Left main plus triple-vessel disease	39.5	38.7
Right coronary artery disease	53.7	53.7
Restenotic lesion	1.9	1.8

Results

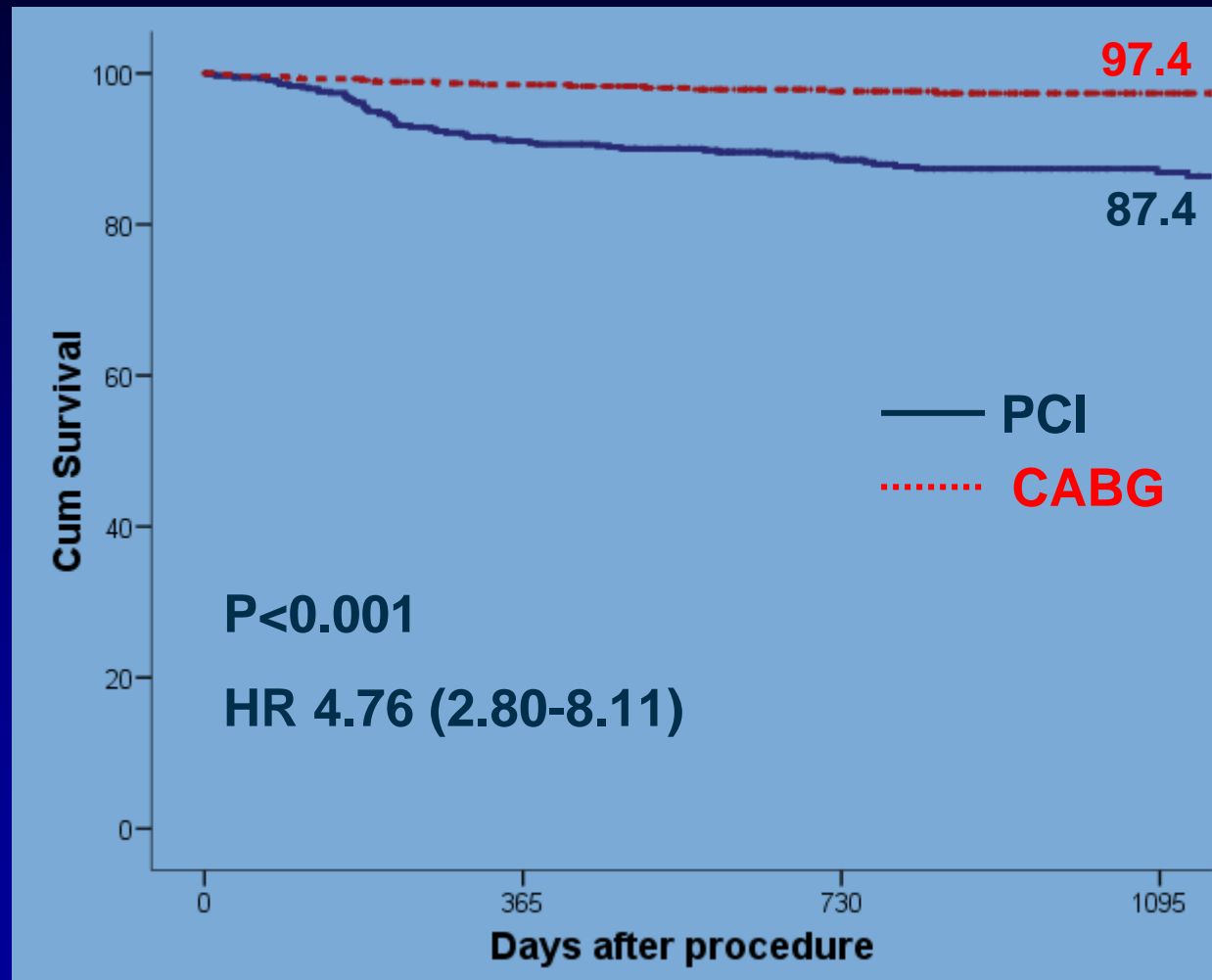*Outcomes of Propensity-Matched Cohort (N=542)*

Stent vs. CABG

Death upto 3 Year
(Paired Kaplan-Meier Analysis)
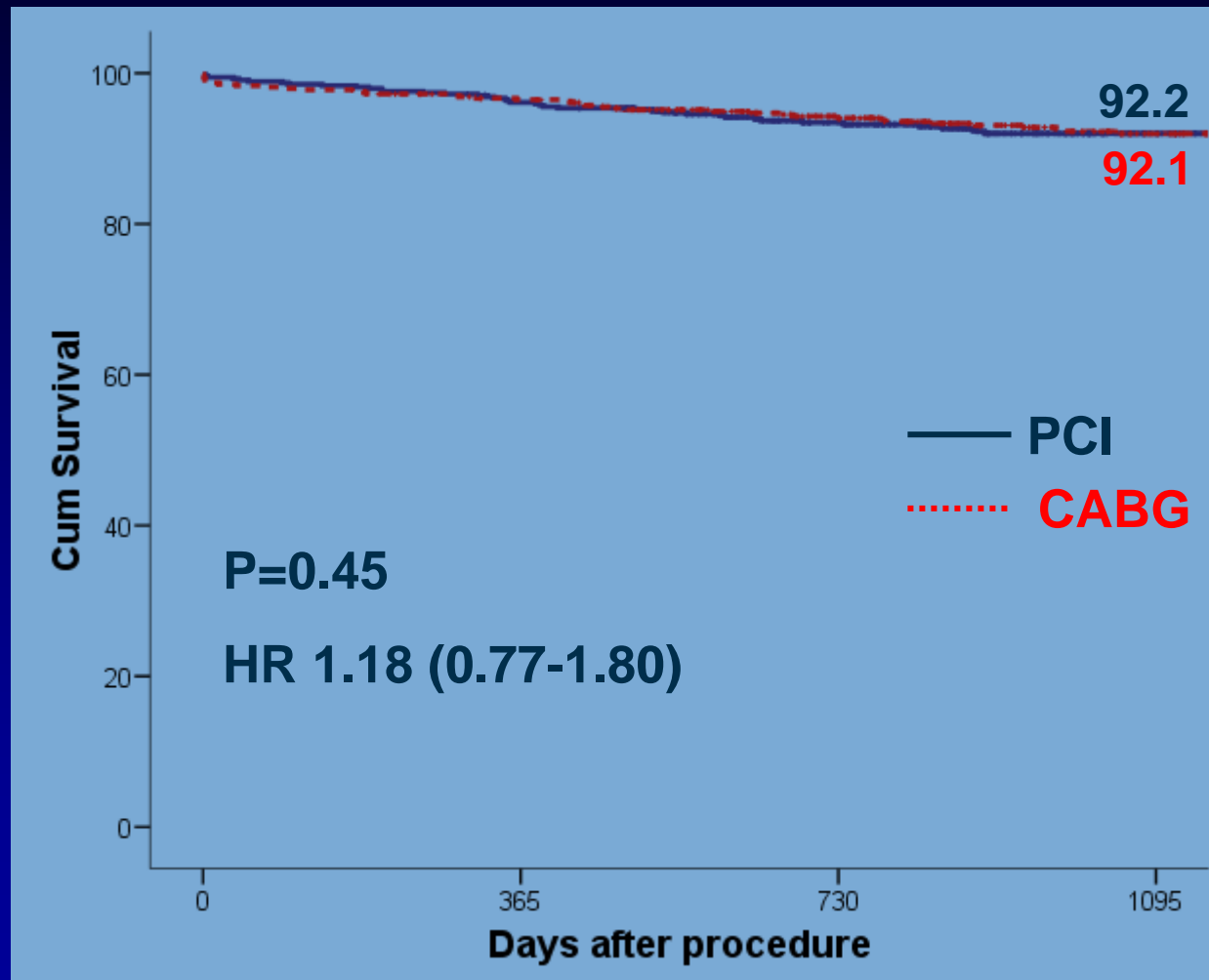
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Death, Q-MI, or Stroke upto 3 Year
(Paired Kaplan-Meier Analysis)
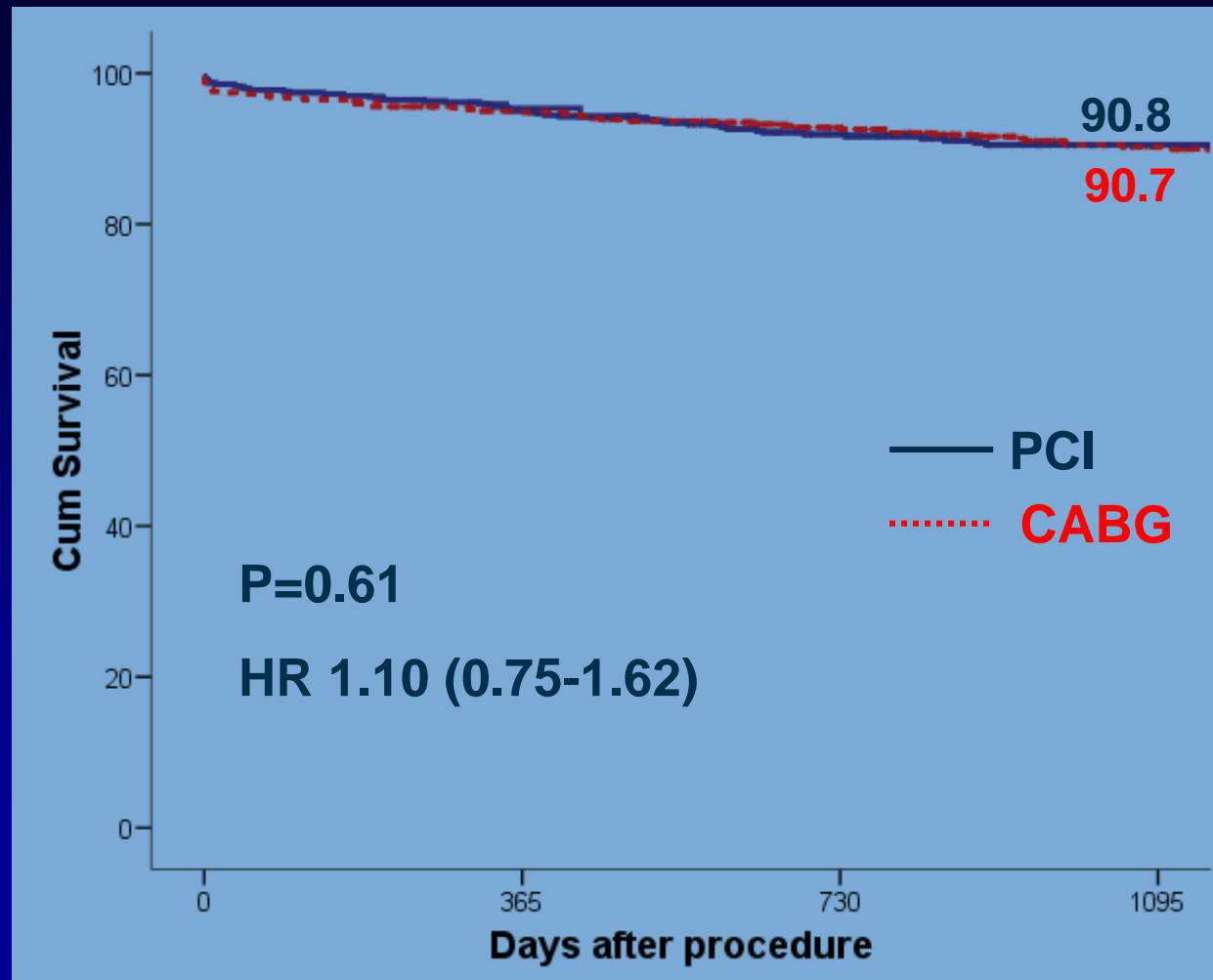
TVR upto 3 Year
(Paired Kaplan-Meier Analysis)

After Propensity-Matching in BMS era (N=207)

BMS vs. CABG

Baseline Characteristics of Propensity-Matched Patients (207 pairs)

Variable	BMS (n=207)	CABG (n=207)
Demographic characteristics		
Age (yr)		
Median	61	61
Interquartile range	51-69	53-67
Male sex (%)	72.0	71.0
Cardiac or Coexisting conditions (%)		
Diabetes mellitus		
Any diabetes	26.1	26.6
Requiring insulin	4.9	5.3
Hypertension	44.9	45.1
Hyperlipidemia	27.1	27.2
Current smoker	28.5	28.2

Baseline Characteristics of Propensity-Matched Patients

Variable	BMS (n=207)	CABG (n=207)
Previous coronary angioplasty	14.0	14.6
Previous myocardial infarction	9.7	10.5
Previous congestive heart failure	2.4	2.8
Chronic obstructive pulmonary disease	2.1	1.9
Cerebrovascular disease	6.7	6.3
Peripheral vascular disease	1.0	1.0
Renal failure	1.9	2.4
Ejection fraction (%)		
Median	61	61
Interquartile range	57-67	56-66

Baseline Characteristics of Propensity-Matched Patients

Variable	BMS (n=207)	CABG (n=207)
Electrocardiographic findings		
Sinus rhythm	97.6	97.1
Atrial fibrillation	2.4	2.9
Other	0.0	0.0
Clinical indication (%)		
Silent ischemia	2.9	3.4
Chronic stable angina	16.6	16.4
Unstable angina	69.7	69.6
NSTEMI	10.8	10.6

Baseline Characteristics of Propensity-Matched Patients

Variable	BMS (n=207)	CABG (n=207)
Angiographic characteristics (%)		
Extent of diseased vessel		
Left main only	21.3	21.3
Left main plus single-vessel disease	29.0	29.0
Left main plus double-vessel disease	33.8	33.8
Left main plus triple-vessel disease	15.9	15.9
Right coronary artery disease	29.5	29.5
Restenotic lesion	2.0	2.4

Results

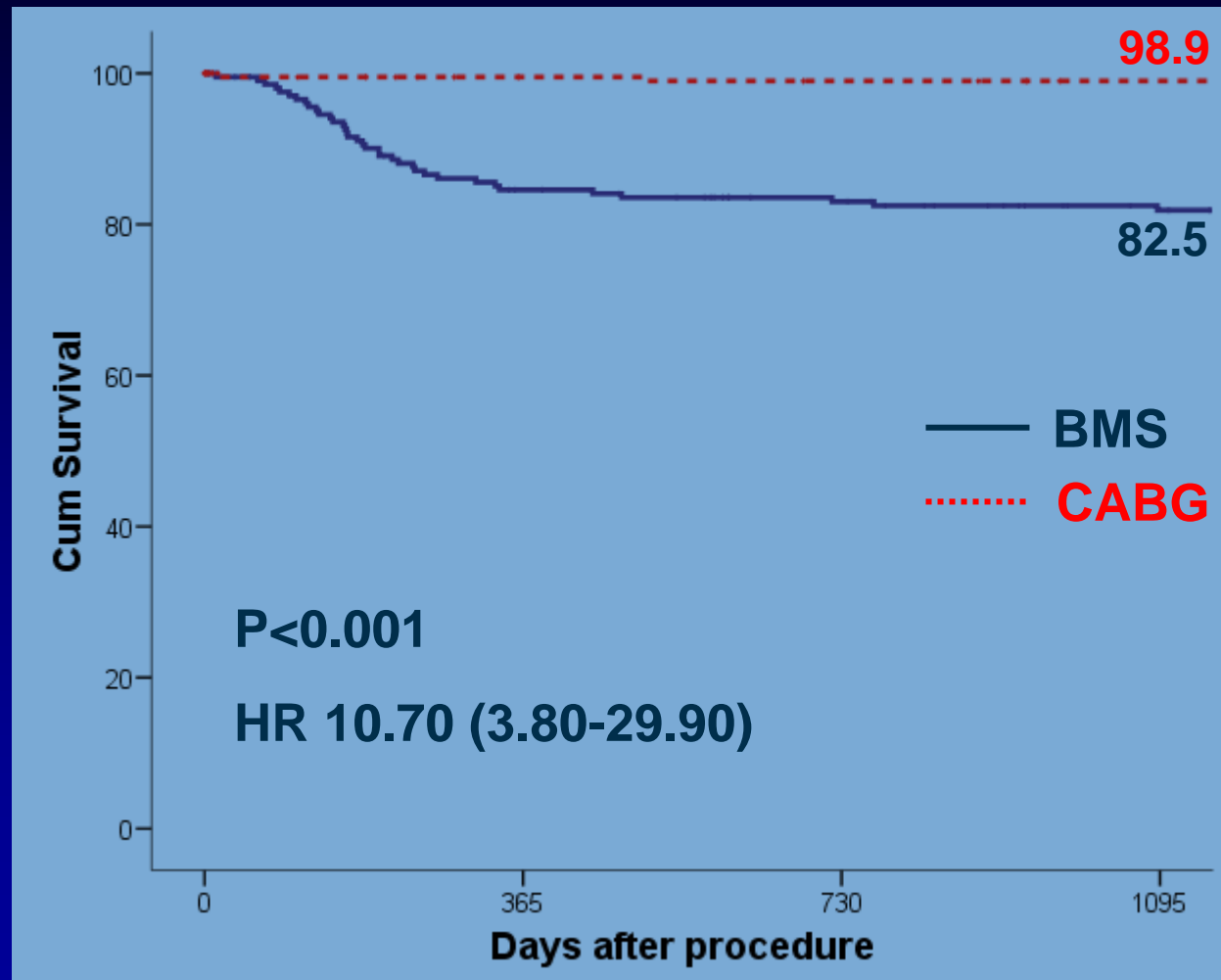*Outcomes of Propensity-Matched Cohort (N=207)*

BMS vs. CABG

Death upto 3 Year
(Paired Kaplan-Meier Analysis)
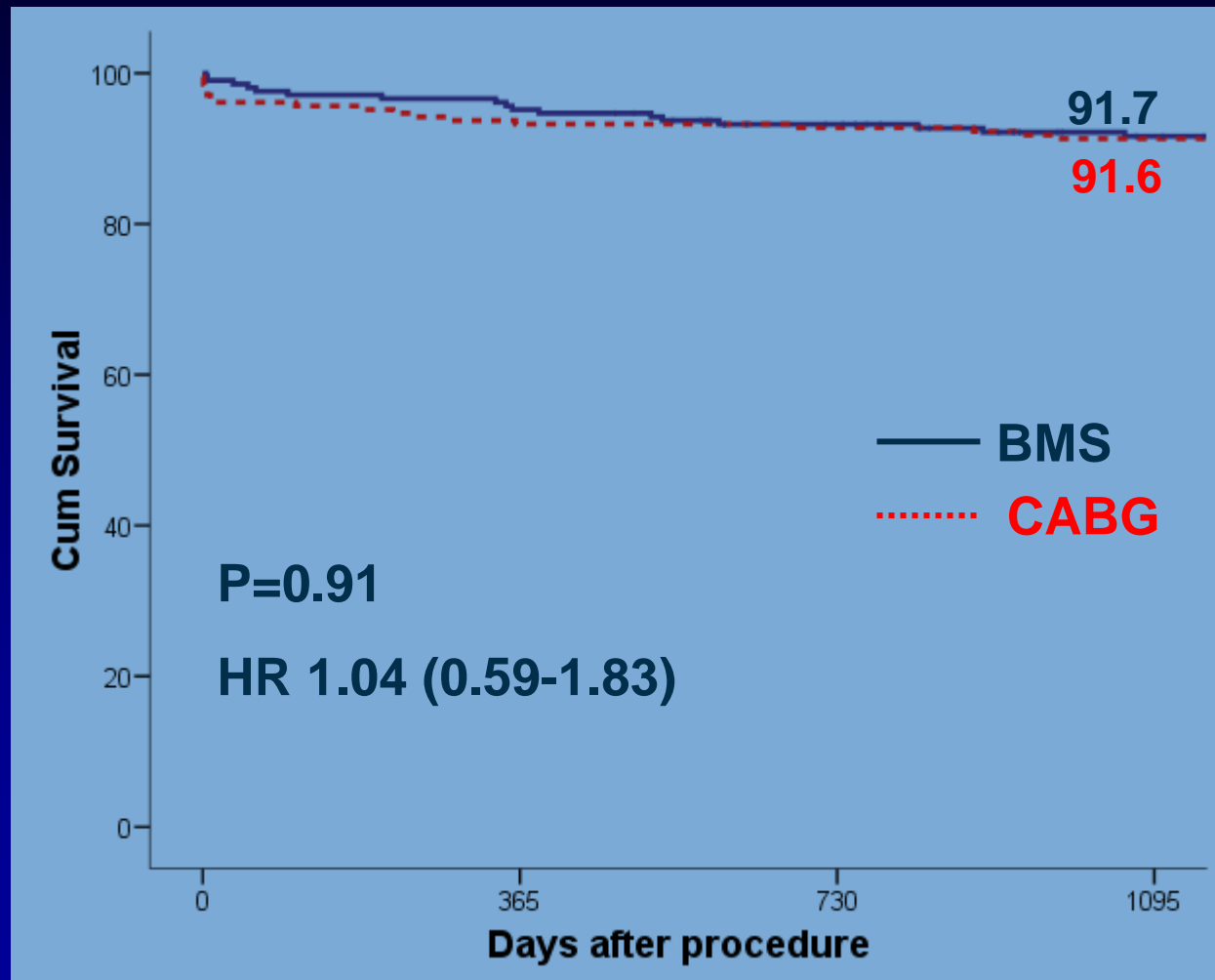
Death, Q-MI, or Stroke upto 3 Year
(Paired Kaplan-Meier Analysis)
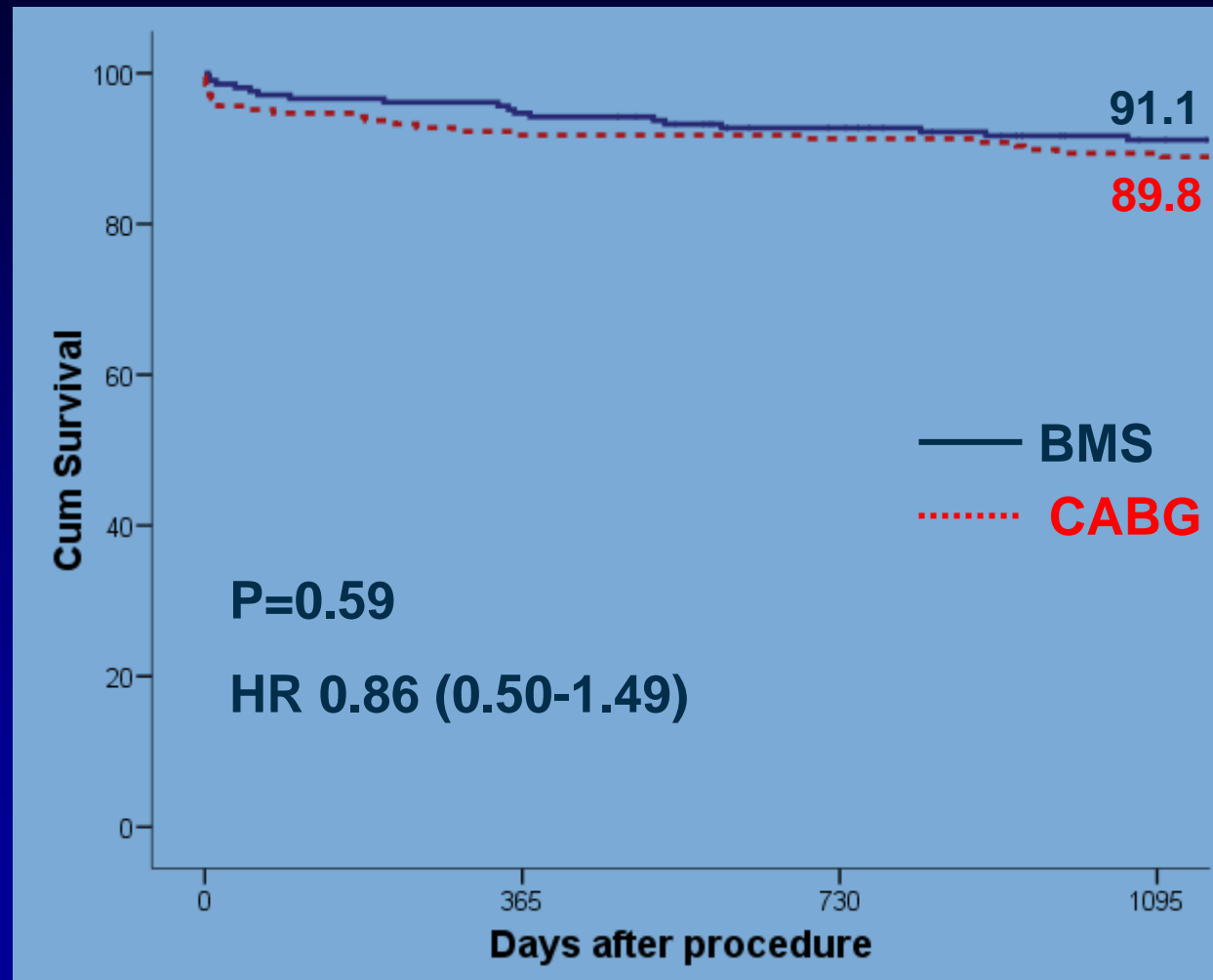
TVR upto 3 Year
(Paired Kaplan-Meier Analysis)

After Propensity-Matching in DES era (N=396)

DES vs. CABG

Baseline Characteristics of Propensity-Matched Patients (396 pairs)

Variable	DES (n=396)	CABG (n=396)
Demographic characteristics		
Age (yr)		
Median	66	66
Interquartile range	57-72	58-70
Male sex (%)	71.5	71.7
Cardiac or Coexisting conditions (%)		
Diabetes mellitus		
Any diabetes	36.0	36.9
Requiring insulin	10.1	10.9
Hypertension	52.3	53.0
Hyperlipidemia	32.6	33.6
Current smoker	26.3	25.5

Baseline Characteristics of Propensity-Matched Patients

Variable	DES (n=396)	CABG (n=396)
Previous coronary angioplasty	14.4	14.4
Previous myocardial infarction	8.8	9.3
Previous congestive heart failure	3.0	3.3
Chronic obstructive pulmonary disease	2.8	2.5
Cerebrovascular disease	8.0	7.3
Peripheral vascular disease	2.5	3.3
Renal failure	5.3	4.8
Ejection fraction (%)		
Median	60	60
Interquartile range	55-66	56-66

Baseline Characteristics of Propensity-Matched Patients

Variable	DES (n=396)	CABG (n=396)
Electrocardiographic findings		
Sinus rhythm	97.7	96.5
Atrial fibrillation	2.3	3.0
Other	0.0	0.5
Clinical indication (%)		
Silent ischemia	2.3	2.8
Chronic stable angina	30.1	28.8
Unstable angina	57.8	57.8
NSTEMI	9.8	10.6

Baseline Characteristics of Propensity-Matched Patients

| Variable	DES (n=396)	CABG (n=396)
Angiographic characteristics (%)		
Extent of diseased vessel		
Left main only	5.8	5.8
Left main plus single-vessel disease	12.4	11.6
Left main plus double-vessel disease	28.0	30.0
Left main plus triple-vessel disease	52.8	53.0
Right coronary artery disease	65.9	66.9
Restenotic lesion	1.8	1.3

Results

Outcomes of Propensity-Matched Cohort (N=396)

DES vs. CABG

Death upto 3 Year
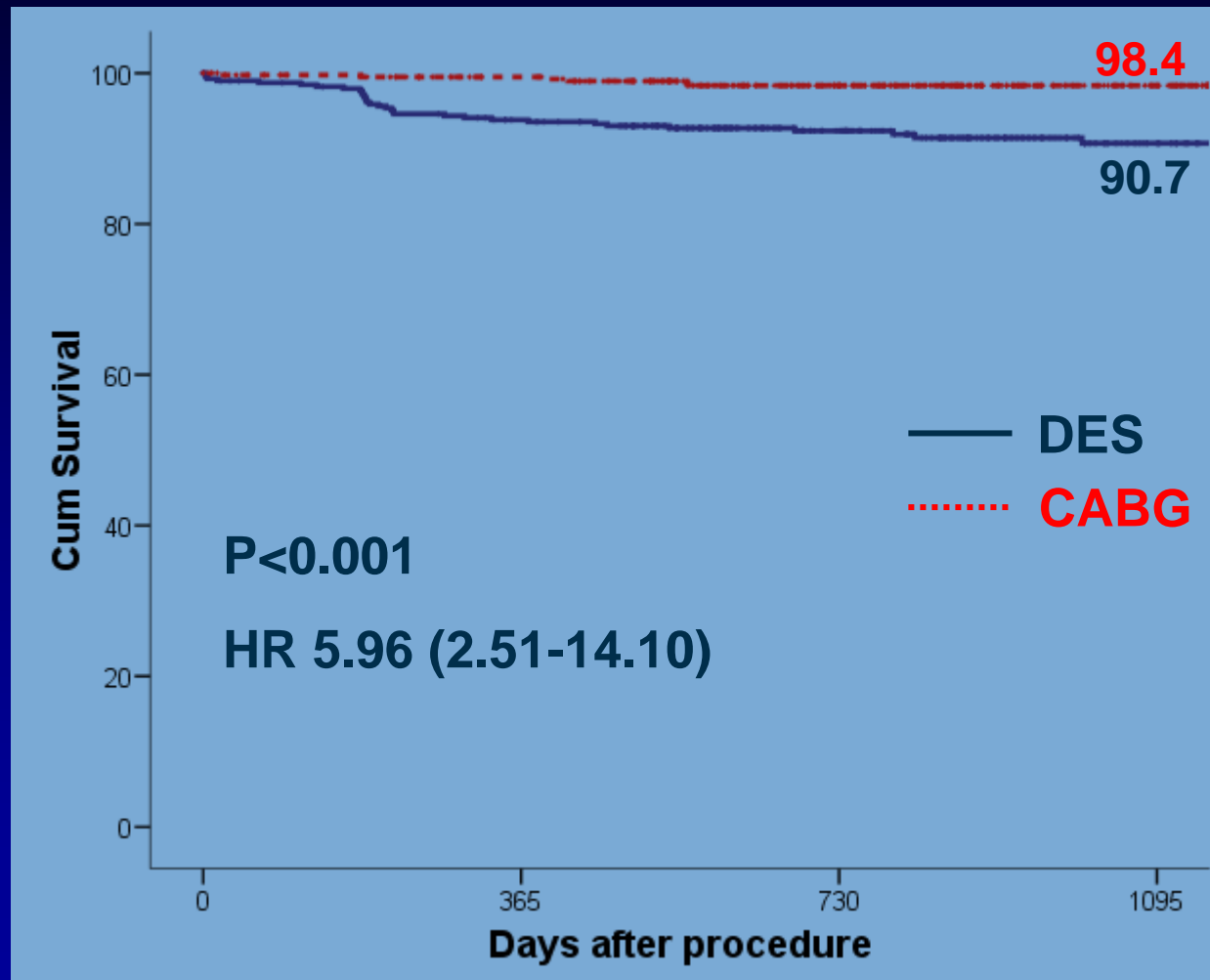(Paired Kaplan-Meier Analysis)
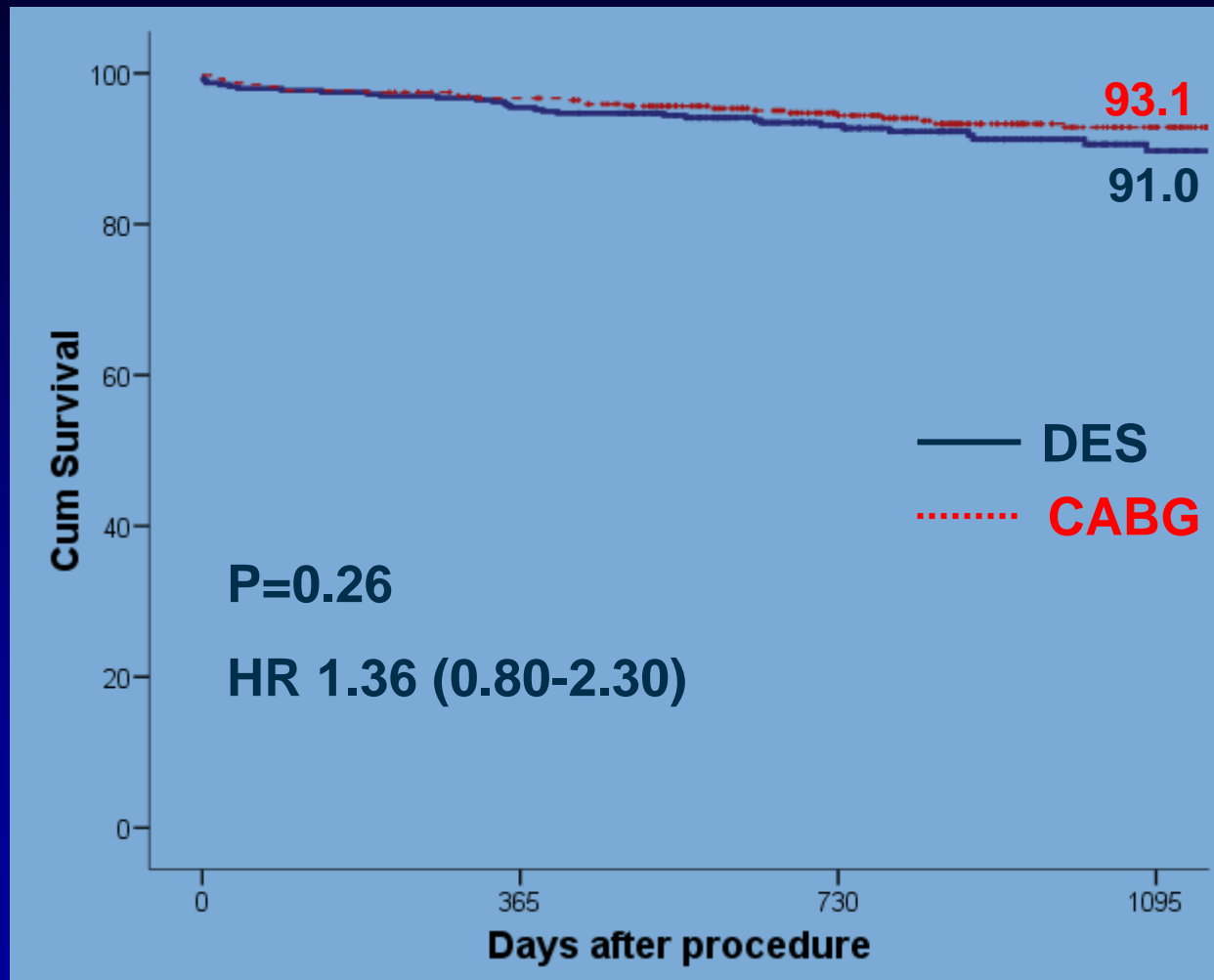
Death, Q-MI, or Stroke upto 3 Year
(Paired Kaplan-Meier Analysis)

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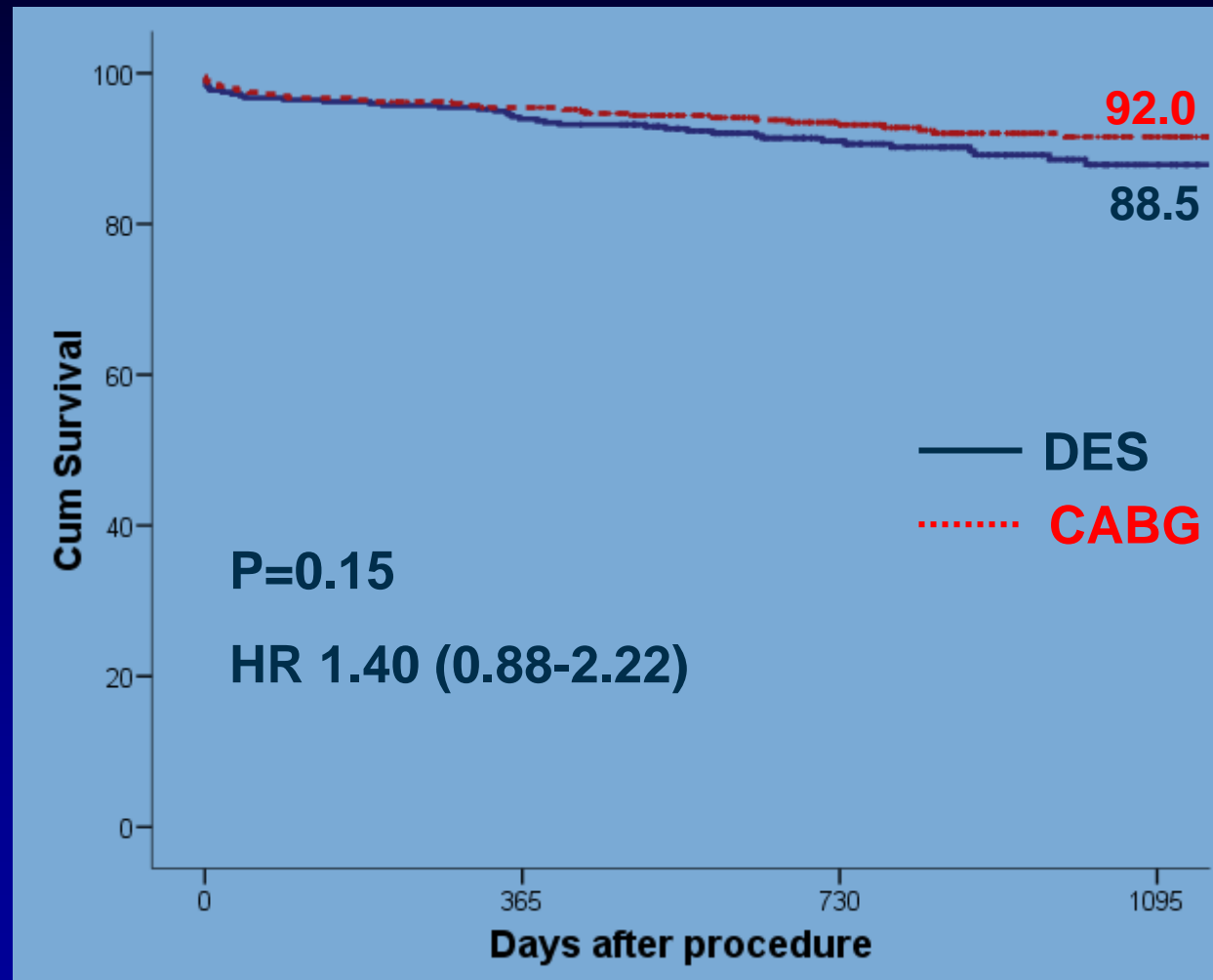
Conclusions from MAIN-COMPARE Registry

- In Korea, PCI for Unprotected LM disease has been exclusively performed in the low-surgical patients for CABG, implying that PCI for LMCA disease is common practice comparable to CABG.

- For the treatment of unprotected LMCA disease, stenting, both BMS and DES, showed equivalent long-term mortality and serious ischemic complications (death, Q-wave MI, or stroke) as CABG.

Conclusions from MAIN-COMPARE Registry

- Despite significant reduction of TVR with DES compared to BMS, CABG was still more effective in reducing TVR than stenting.

- These findings should be ascertained and refuted through large, randomized clinical trials.